REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the present amendments and following discussion is respectfully requested.

Claims 1-69 are presently active. Claims 1, 32, 63, and 66 have been presently amended. Claims 67-69 have been added.

In the outstanding Office Action, Claim 32 was objected to. Claims 1-66 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting over Claims 1-44, 1-58, 1-48, 1-78, and 1-62 of co-pending Application Nos. 10/673,138; 10/673,467; 10/673,501; 10/673,507; 10/673,583; and 10/673,583, respectively. Claims 1-25, 32-56, and 63-66 were rejected under 35 U.S.C. § 103 as being unpatentable over Sonderman et al (U.S. Pat. No. 6,802,045) in view of Kee et al (U.S. Pat. No. 5,583,780).[1] Claims 26-28 and 57-59 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sonderman et al and Kee et al in view of Fatke et al (U.S. Pat. Appl. No. 200510016947).

Regarding the rejection on the merits:

Briefly recapitulating, Claim 1 defines a method of facilitating a process performed by a semiconductor processing tool including:

> 1) inputting process data relating to an actual process being performed by the semiconductor processing tool,
> 2) inputting a first principles physical model including a set of computer-encoded differential equations, the first principles physical model describing at least one of a basic physical or chemical attribute of the semiconductor processing tool,
> 3) performing first principles simulation ***for the actual process being performed*** using the physical model to provide a first principles simulation result in accordance with the process data relating to the actual process being performed in order to simulate the actual process being performed, and

[1] Applicant request that Kee et al be listed on a PTO 892 form as a reference applied in the Office Action.

4) using the first principles simulation result to determine a fault in the actual process being performed by the semiconductor processing tool.[2]

The present response presents in synopsis first and later in detail two main points which show the patentable differences between the presently claimed invention and the asserted combination of Sonderman et al and Kee et al.

First, Sonderman et al fail to disclose or suggest a ***first principles physical model*** including a set of computer-encoded differential equations or performing first principles simulation ***for the actual process being performed***.

Second, the deficiencies in Sonderman et al are not overcome by Kee et al. Thus, a combination of Sonderman et al and Kee et al would not produce the claimed invention.

Regarding the first point, the Court in *Environmental Designs Ltd. v. Union Oil Co.*, 713 F.2d 693, 218 USPQ 865 (Fed. Cir. 1983) indicates that the examiner must ascertain what would have been obvious to one of ordinary skill in the art at the time the invention was made, and not to the inventor, a judge, a layman, those skilled in remote arts, or to geniuses in the art at hand. In the present case, there appears to be disagreement between the Applicant and the examiner as to whether or not Sonderman et al discloses or suggests the claimed first principles physical model by their disclosure of a device physics model, a process model, and an equipment model.

One question with regard to the first point is whether one of ordinary skill in the art would recognize from the teachings of Sonderman et al (as a whole) a disclosure or suggestion of a first principles physical model. To this point, specifically with regard to how one of ordinary skill in the art would interpret the teachings of Sonderman et al for a device physics model, a process model, and an equipment model, Applicant submits that the article

[2] The enumerations have been added purely for the purpose of referencing these elements in the present discussion.

"1999 Casting Simulation Software Survey" from the AFS Process Design & Modeling Committee (this article now of record by way of the Information Disclosure Statement filed herewith) shows that one of ordinary skill in the art recognizes three different types of computer simulation tools:

1) empirical programs based on experimental results and experience;

2) semi-empirical programs based on experimental results in addition to basic physics; and

3) physics-based ***first principles*** programs that require complex mathematics and accurate material thermophysical data.

Hence, this article shows that one of ordinary skill in that art would both 1) understand a first principles physical model to be fundamentally different than empirical models and 2) understand, since the device physics model, the process model, and the equipment model in Sonderman et al are not disclosed or taught to be first principles models, that these models are either empirically or semi-empirically based. Indeed, the most rigorous disclosure in Sonderman et al is the disclosure of statistical response functions denoted by eqns. 1 and 2 at col. 9 of Sonderman et al, which is an example of an empirical-based model, not a first principle simulation.

Another question with regard to the first point is whether Sonderman et al disclose providing simulation results ***for an actual process being performed.***

The Office Action asserts that Sonderman et al in cols. 5-7 disclose providing simulation results in accordance with process data relating to the actual process being performed. To this assertion, below is a reproduction of the various relevant disclosures of Sonderman et al including inserted comments in **[bold brackets]** which point out that the simulations of Sonderman et al are not simulations for an actual process being performed. Sonderman et al disclose that:

> Once the system 100 performs the process simulation function, the system 100 performs an interfacing function, which facilitates interfacing of the simulation data with the process control environment 180 (block 430). **[Note that the simulation is performed and then the simulation data passed to the process control.]** The process control environment 180 can utilize the simulation data in order to modify or define manufacturing control parameters that control the actual processing steps performed by the system 100. Once the system 100 interfaces the simulation data with the process control environment 180, the system 100 then performs a manufacturing process based upon the manufacturing parameters defined by the process control environment 180 (block 440). **[Note that the process control of the current process is based on a pre-existing simulation.]** Col. 6, lines 35-47.
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> Turning now to FIG. 6, in one embodiment, the system 100 defines the models 310, 320, 330 for execution by the simulator 340. The system 100 then validates the defined models (block 620). **[Note that the need to validate the models means that the simulation results are based on pre-existing model solutions based on historical process data, not provided simulation results produced in accordance with process data relating to the actual process being performed.]** In other words, the system 100 integrates the defined models, such as the device physics model 310, the process model 320, and the equipment model 330, into a single manufacturing unit that is controlled by the simulator 340. Using the validated models, the simulation environment 210 can emulate the operations of an actual process control environment 180 that is integrated with a manufacturing environment 170. Col. 6, line 64, to Col. 7, line 7.
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> Once the system 100 validates the defined models, the system 100 acquires data to operate the defined models (block 630). In one embodiment, the system 100 acquires data from the computer system 130 in order to operate the defined models. The system 100 then populates the defined models with the data acquired by the system 100 for operation of the models (block 640). In other words, the system 100 sends operation data, control parameter data, simulation data, and the like, to the defined models so that the defined models can perform a simulation as if an actual manufacturing process were being performed. **[Note that if Sonderman et al were simulating an actual manufacturing process, then the disclosure here would not have stated "as if an actual manufacturing process were being performed."]** The completion of the steps described in FIG. 6 substantially completes the step of preparing process models for simulation, as indicated in block 510 of FIG. 5. Col. 7, lines 8-20.

Accordingly, Applicant submits that the disclosure of Sonderman et al does not disclose (and indeed teaches away from) the claimed invention in which a first principles simulation is performed ***for the actual process being performed*** in order to simulate the actual process being performed.

If examiner disagrees, Applicant would greatly appreciate an explanation of how this disclosure in Sonderman et al is being otherwise interpreted.

Regarding the second point, Kee et al disclose the use of radiation models to predict the spectral radiation transport in thermal systems.[3] In the Abstract, Kee et al explicitly disclose that the ***predicted*** model of the thermal system is used to design and control the thermal system. Kee et al in detail disclose that:

> The modeling apparatus 101 of the instant invention may also be used to perform an inverse analysis to establish the boundary conditions or parameter values required to achieve a certain function of the thermal system. This allows the apparatus to be used to establish the appropriate process parameters and boundary conditions for the thermal system modeled. In accordance with the instant invention, the inverse analysis can be directly carried out by the modeling apparatus ***rather than using the conventional approach, which merely solves the direct problem repeatedly, in a lengthy and costly iterative process***, to determine appropriate input parameters to achieve a desired result. In other words, in accordance with the instant invention, ***once a particular thermal process is modeled for a particular set of control parameters***, the device may then be used to automatically obtain the necessary control parameters to achieve a desired result by providing the modeling apparatus with parameters corresponding to the desired result.
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> To carry out the inverse analysis, the modeling apparatus 101 includes an inverse parameter input section 104 also connected to input device 103. A user inputs into the modeling apparatus 101 parameters corresponding to desired results, e.g., desired temperature characteristics of the system, which are stored in memory 108. The processing unit 110, under control of modeling program 111, ***uses the previously generated model*** of the thermal system and the parameters held in memory 108 and derives or predicts particular control parameters to meet the constraints entered through the inverse parameter input section 104. This process is more fully described below in connection with the examples provided.[4] [emphasis added]

Thus, Kee et al in recognizing the difficulties of the conventional approach, "which merely solves the direct problem repeatedly, in a lengthy and costly iterative process," develops process control based on a previously generated model, and by an inverse analysis of that previously generated model predicts process control. Thus, Kee et al disclose the use of pre-

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[3] Kee et al, see Abstract.
[4] Kee et al, col. 4, lines 21-50.

generated model results to control the reactor, and like Sonderman et al do not disclose or suggest performing a first principle simulation for an actual process being performed.

The difficulties of the conventional approach referred to by Kee et al are exemplified by the proposed development in Jain et al of a mathematical physical engine (MPE) to address the solutions of complicated partial differential equations. Applicant directs the examiner's attention to this reference of record, as the Jain et al reference is applied in several of the related applications as part of a 103(a) rejection. Nevertheless, Applicant believes that Jain et al supports Applicant's position that one of ordinary skill in the art in recognizing the difficulty of first principle simulations would therefore understand (1) the disclosure of Sonderman et al not to be a first principles teaching and (2) the disclosure of Kee et al to be a solution that does not have to invoke a first principles simulation for an actual process being performed.

Jain et al disclose at pages 372-373 that:

> We ***propose*** a wafer scale implementation of the MPE. The starting point would be a dedicated processing cell, optimized specifically for the PDE arithmetic and data routing. Because of the relative simplicity of the cell, it is expected that extremely large arrays (8x8 to 32x32) ***could be*** successfully processed on a single piece of silicon using Wafer Scale Integration techniques. In fact, we have already laid the foundation for the development of such a processing cell. Our Universal Multiply-Subtract-Add [11] ***could be*** adapted for this first cell design. Similarly, our nonlinear coprocessor cell [12]-[14] ***might be used*** in conjunction with the UMSA to provide advanced mathematical functions. As suggested in Fig. 2, there would be ***courtyards of processors***, each with two interconnection networks and two memory banks. 2-D, 3-D, and 4-D problems could then be mapped for parallel computations. Since inter-processor delays are very small (say a few ns), extremely high speeds could be achieved. This, together with the high degree of parallelism, would result also in high throughout. We ***envision*** 100 to 1000 processors (on one wafer) forming a wafer scale MPE. At a clock frequency of 50 MHz, a single wafer could achieve up to 20 GFLOPs performance. With our nonlinear coprocessor added, each instruction could equate to multiple floating point operations. Furthermore, because of the extendible architecture, several wafers ***could be*** interconnected as shown in Fig. 5 to construct a "stacked" MPE wafer system (SMPE). Note that no vertical interconnects within the stack of wafers are expected. Tens to hundreds of GFLOPs performance in a volume the size of a desk-top computer [15] ***could*** thus be achieved. However, ***these predictions*** ignore the likely technical advances in the next

> five years; a tenfold further increase in performance might be achievable. [Emphasis Added]

Accordingly, Applicant submits that one of ordinary skill in the art (aware as Jain et al were of the complexities of real time solutions to first principles models) would recognize Kee et al as a teaching of using previously generated models and an inverse analysis of these models for process control (as disclosed) and not a teachings (nor a suggestion) of performing simulation results for an actual process being performed.

Hence, the deficiencies of Sonderman et al are not overcome by Kee et al, and the asserted combination of Sonderman et al and Kee et al would not produce the claimed invention.

For all these reasons, the present invention is believed to patentably define over Sonderman et al and Kee et al individually or in combination.

Regarding the clam objection:

Claim 32 has been amended as suggested in the Office Action. Thus, it is respectfully requested that the claim objection has been overcome.

Regarding the provisional double-patenting rejection:

Applicant submits that a terminal disclaimer can be filed, if the claims in the present application and the claims in the co-pending Application Nos. 10/673,138; 10/673,467; 10/673,501; 10/673,507; 10/673,583; and 10/673,583 remain obvious in view of each other at the time of allowance of either of these applications. Indeed, M.P.E.P. ∍ 804.02 IV states that, prior to issuance, it is necessary to disclaim each one of the double patenting references applied. Hence, Applicant respectfully requests that the examiner contact the undersigned should the present arguments be accepted and should the case be otherwise in a condition for

allowance. At that time, a terminal disclaimer can be supplied to expedite issuance of this case.

New Dependent Claims 67-69

New Claims 67-69 define the reuse of known solutions as initial conditions for the first principles simulation for an actual process being performed. This feature is supported by numbered paragraph [0048] in the originally filed specification. No new matter is added. This feature provides further distinction of the present invention from the art of record.

Conclusion:

As discussed above, the issues identified in the outstanding Office Action for this patent application have been addressed, placing all the claims in a condition for allowance.

Consequently, in view of the above discussions, the application is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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